Disciplinary Core Ideas in Science Performances

Building Capacity in Science Instruction through the Framework for K-12 Science Education

A Workshop for Science Educators and Leaders
Presented by Utah State Office of Education

Dixie State University

and

Partnership for Effective Science Teaching and Learning

Dixie Sate University Conference Center
St. George Utah

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Overview

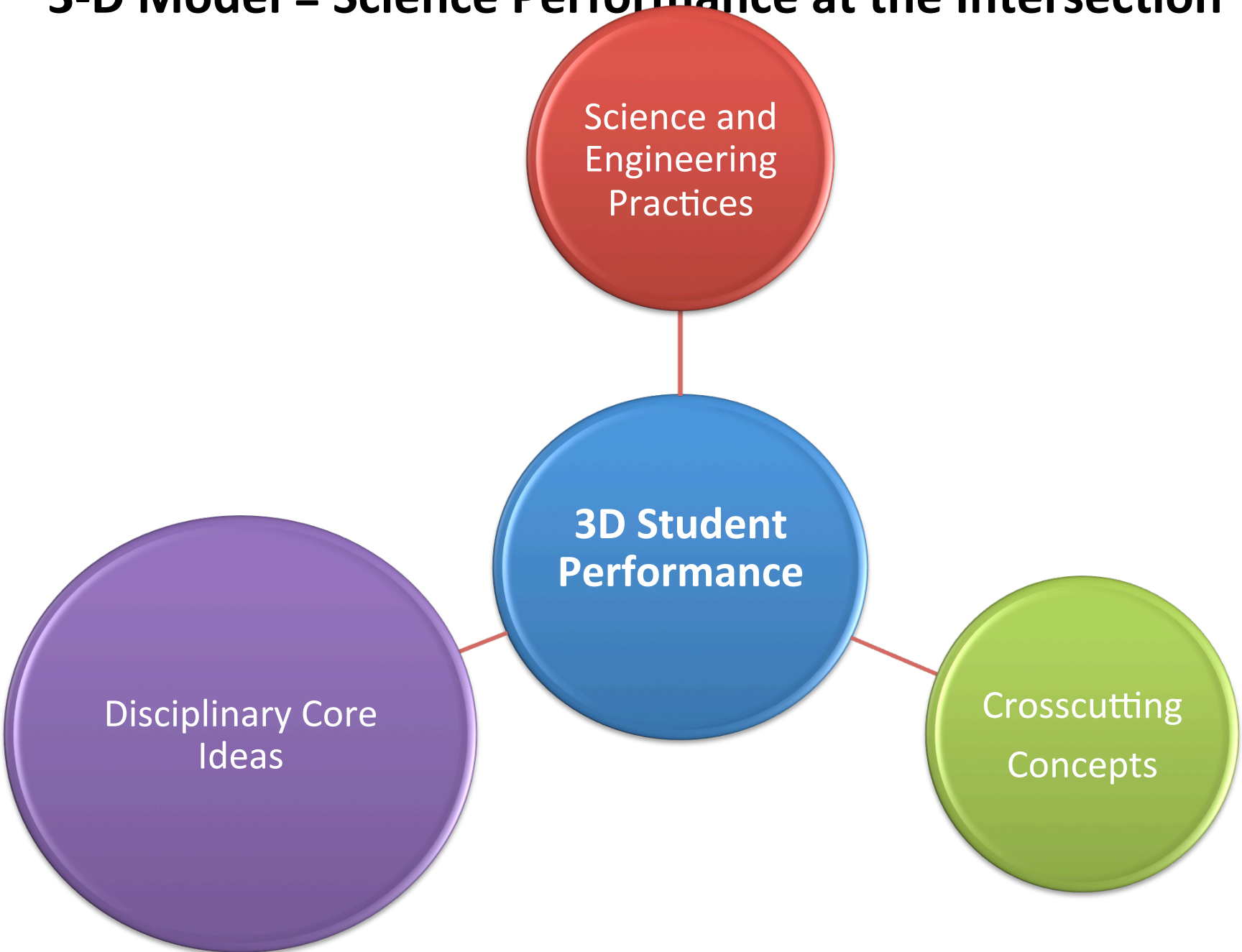
- A Shift to a New Vision for Science Education
- Core Ideas as Evidence
- Core Ideas in Performances of Science
- Discussion

The *Framework* is Designed to Help Realize a Vision of Science Education

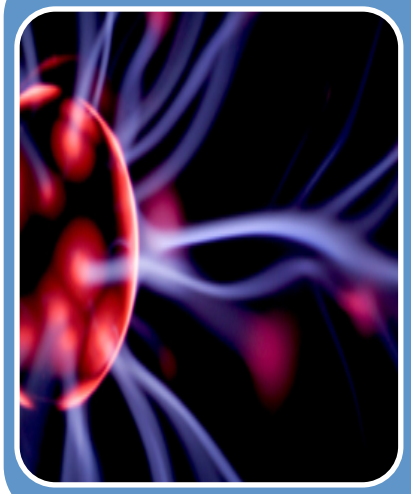
- A vision of science education in which all students' experiences over multiple years foster progressively deeper understanding of science.
- Students actively engage in scientific and engineering practices in order to deepen their understanding of crosscutting concepts and disciplinary core ideas.
- In order to achieve the vision embodied in the *Framework* and to best support students' learning, all three dimensions should to be integrated into the system of standards, curriculum, instruction, and assessment.

NRC Framework Page 217

3-D Model = Science Performance at the Intersection



Disciplinary Core Ideas



Physical Science

- PS1: Matter and Its Interactions
- PS2: Motion and Stability: Forces and Interactions
- PS3: Energy
- PS4: Waves and Their Applications in Technologies for Information Transfer

Life Science

- LS1: From Molecules to Organisms: Structure and Processes
- LS2: Ecosystems: Interactions, Energy, and Dynamics
- LS3: Heredity: Inheritance and Variation of Traits
- LS4: Biological Evolution: Unity and Diversity

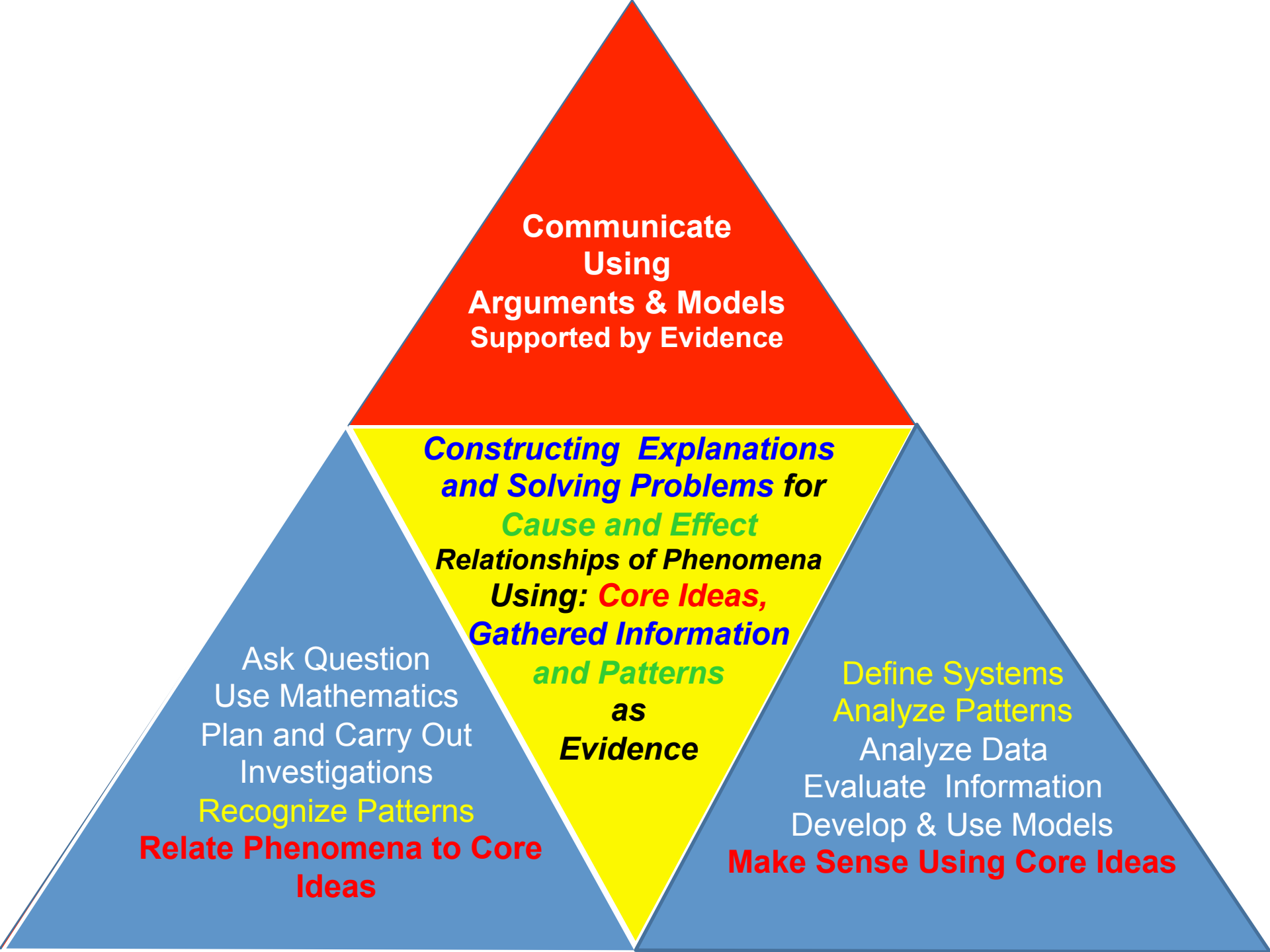
Disciplinary Core Ideas

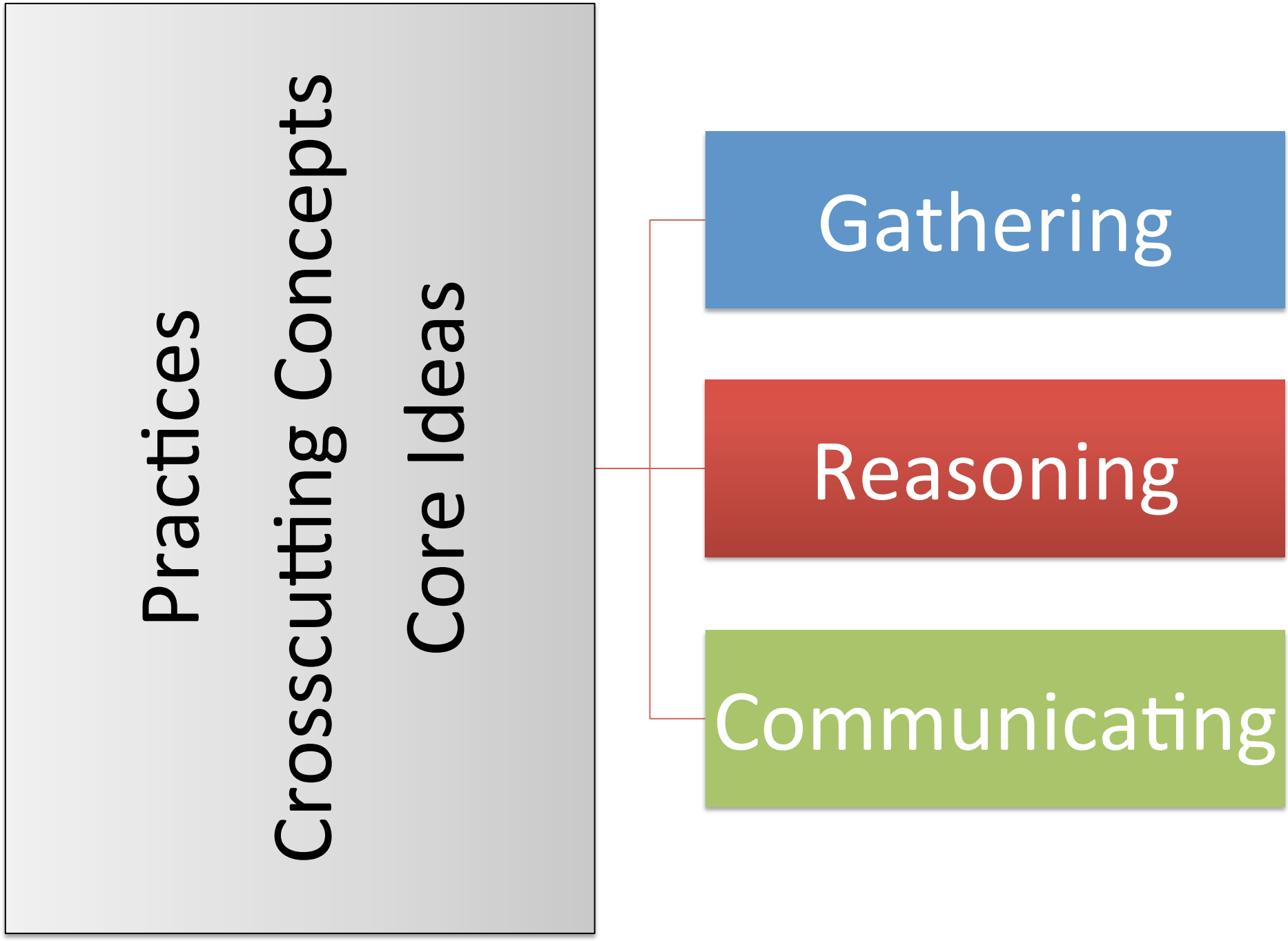
Earth and Space Science

- ESS1: Earth's Place in the Universe
- ESS2: Earth's Systems
- ESS3: Earth and Human Activity

Engineering, Technology, and Applications of Science

- ETS1: Engineering Design
- ETS2: Links Among Engineering, Technology, Science, and Society


Communicate
Using
Arguments & Models
Supported by Evidence
Constructing Explanations
and Solving Problems for
Cause and Effect
Relationships of Phenomena
Using: Core Ideas,
Gathered Information
and Patterns
as
Evidence
Ask Question
Use Mathematics
Plan and Carry Out
Investigations
Recognize Patterns
Relate Phenomena to Core
Ideas
Define Systems
Analyze Patterns
Analyze Data
Evaluate Information
Develop & Use Models
Make Sense Using Core Ideas


Practices
Crosscutting Concepts
Core Ideas
Gathering
Reasoning
Communicating

The Rocky Mountains

- Most high mountains ranges are found near plate boundaries
- The Rocky Mountains are nearly 2000 miles from a plate boundary
- What caused the Rocky Mountains to be uplifted?

Group Performance

Investigate how the Rocky Mountains were formed given they are so far inland from a plate boundary.

1. **Gather information** for how the Rocky Mountains formed.
2. Formulate questions and investigate **explanations** for the mechanism that **caused** uplift of the Rocky Mountains.
3. Develop **evidence** from Core Ideas to support your **explanations.**
4. Develop an **argument** supported **by evidence** for how the Rocky Mountains were formed and use a **model to communicate** your argument.

Individual Performance

4. Write in your journal an **explanation** of how the Rocky Mountains of the Western United States were formed and how this process differed from the coastal mountain ranges. Include **evidence** from reliable sources to support your **explanation.**

Group Discussion

Reflection

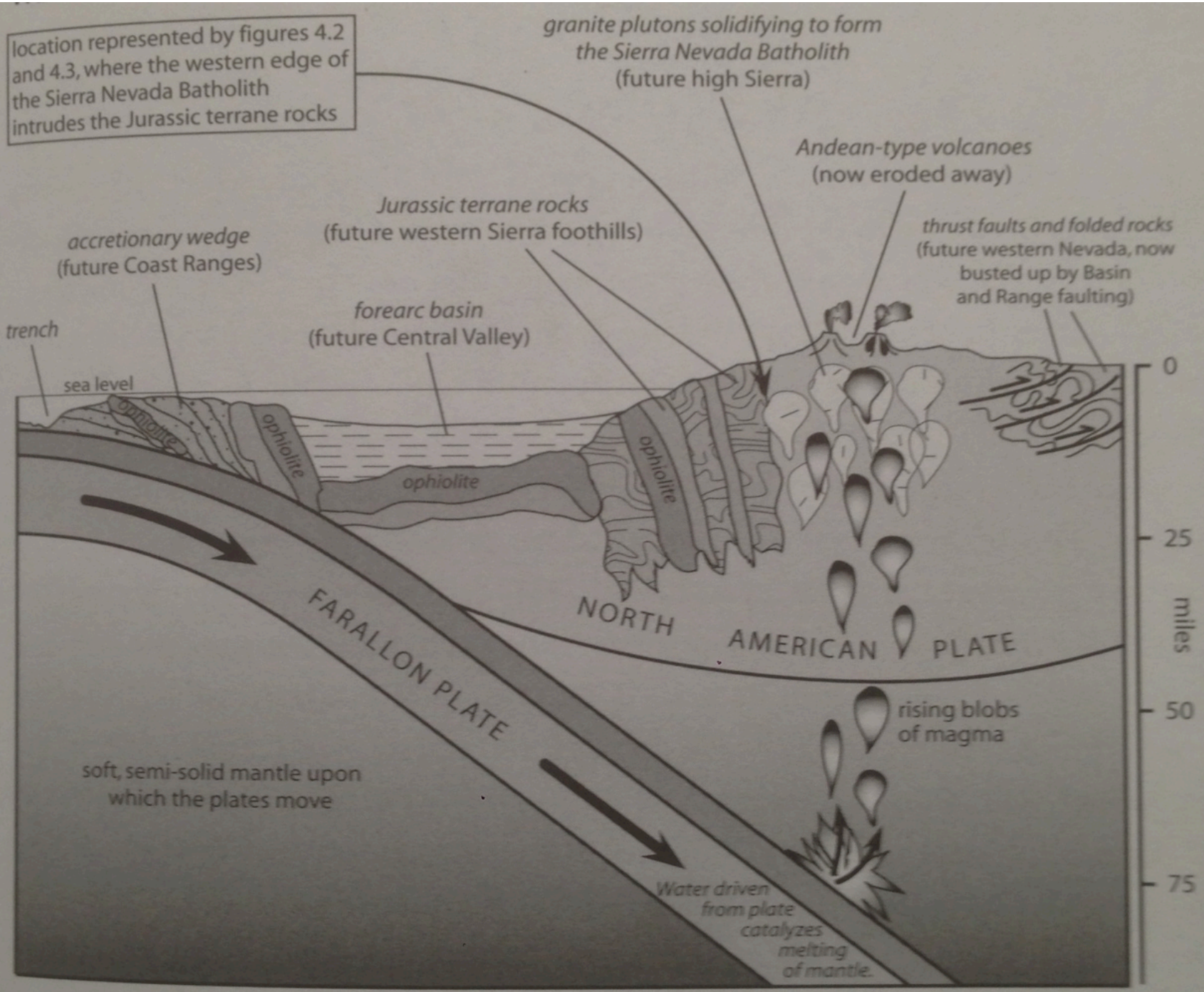
5. Reflect on the Disciplinary Core Ideas of science that are related to the **explanation**. Review the NGSS Appendix E and identify the Core Ideas that are useful to make sense of the phenomenon.

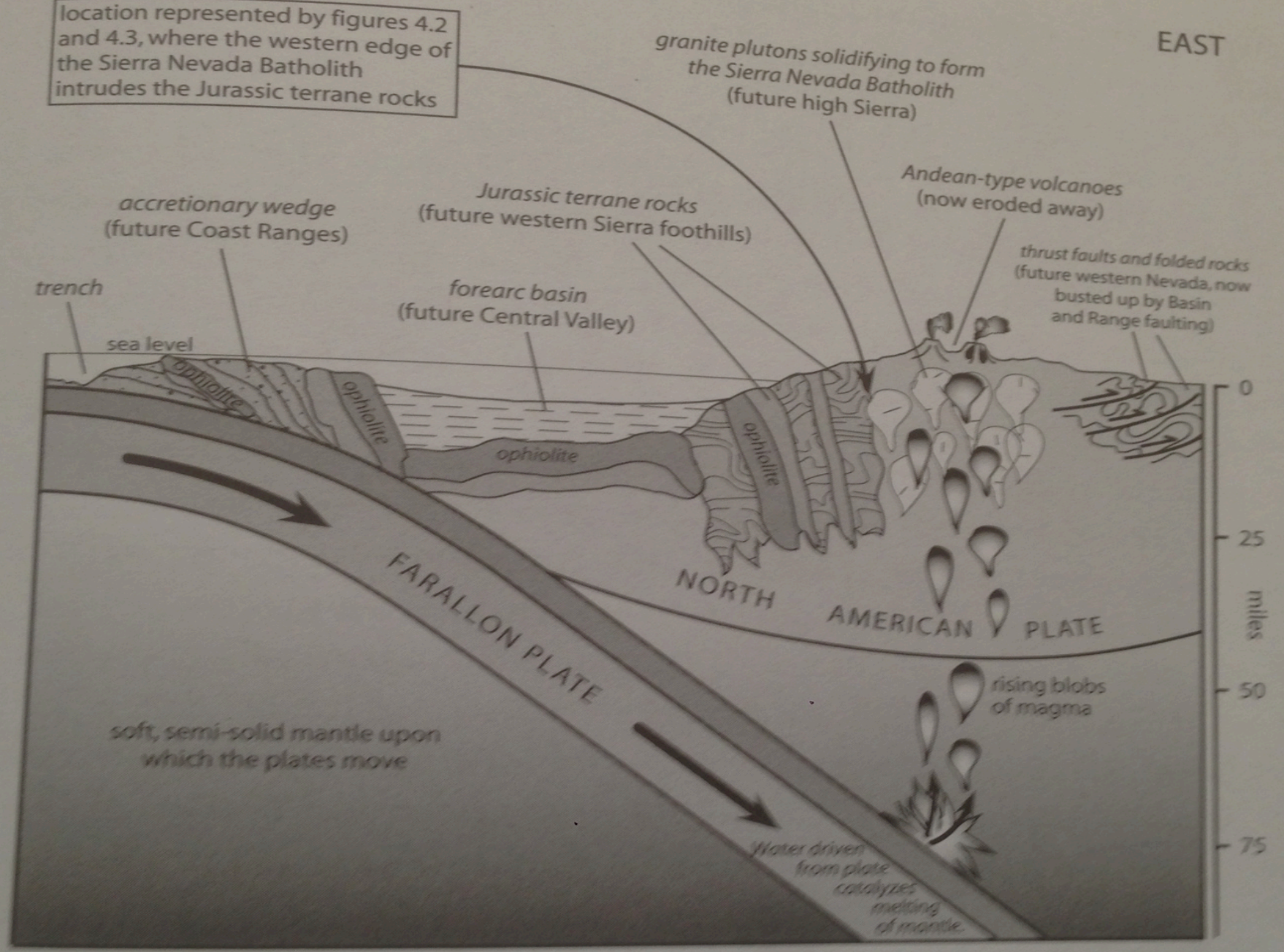
Disciplinary Core Ideas Progression - Appendix E

Disciplinary Core Idea	K-2	3-5	6-8	9-12
ESS1.C The history of planet Earth	Some events on Earth occur very quickly; others can occur very slowly.	Certain features on Earth can be used to order events that have occurred in a landscape	Rock strata and the fossil record can be used as evidence to organize the relative occurrence of major historical events in Earth's history.	The rock record resulting from tectonic and other geoscience processes as well as objects from the solar system can provide evidence of Earth's early history and the relative ages of major geologic formations.
ESS2.B Plate tectonics and large-scale system interactions	Maps show where things are located. One can map the shapes and kinds of land and water in any area.	Plate tectonics is the unifying theory that explains movements of rocks at Earth's surface and geological history. Maps are used to display evidence of plate movement.	Earth's physical features occur in patterns, as do earthquakes and volcanoes. Maps can be used to locate features and determine patterns in those events.	Radioactive decay within Earth's interior contributes to thermal convection in the mantle.

PS DCIs

PS1.A Structure of matter (includes PS1.C Nuclear processes)	Matter exists as different substances that have observable different properties. Different properties are suited to different purposes. Objects can be built up from smaller parts.	Because matter exists as particles that are too small to see, matter is always conserved even if it seems to disappear. Measurements of a variety of observable properties can be used to identify particular materials.	The fact that matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter, phase changes, and conservation of matter.	The sub-atomic structural model and interactions between electric charges at the atomic scale can be used to explain the structure and interactions of matter, including chemical reactions and nuclear processes. Repeating patterns of the periodic table reflect patterns of outer electrons. A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy to take the molecule apart.
PS1.B Chemical reactions	Heating and cooling substances cause changes that are sometimes reversible and sometimes not.	Chemical reactions that occur when substances are mixed can be identified by the emergence of substances with different properties; the total mass remains the same.	Reacting substances rearrange to form different molecules, but the number of atoms is conserved. Some reactions release energy and others absorb energy.	Chemical processes are understood in terms of collisions of molecules, rearrangement of atoms, and changes in energy as determined by properties of elements involved.
PS2.A Forces and motion	Pushes and pulls can have different strengths and directions, and can change the speed or direction of its motion or start or	The effect of unbalanced forces on an object results in a change of motion. Patterns of motion can be used to predict future motion. Some forces act through contact, some forces act even when the objects are	The role of the mass of an object must be qualitatively accounted for in any change of motion due to the application of a	Newton's 2nd law (F=ma) and the conservation of momentum can be used to predict changes in the motion of macroscopic objects.


location represented by figures 4.2 and 4.3, where the western edge of the Sierra Nevada Batholith intrudes the Jurassic terrane rocks
granite plutons solidifying to form the Sierra Nevada Batholith (future high Sierra)
Andean-type volcanoes (now eroded away)
Jurassic terrane rocks (future western Sierra foothills)
accretionary wedge (future Coast Ranges)
thrust faults and folded rocks (future western Nevada, now busted up by Basin and Range faulting)
forearc basin (future Central Valley)
trench
sea level
ophiolite
ophiolite
ophiolite
ophiolite
NORTH AMERICAN PLATE
FARALLON PLATE
rising blobs of magma
soft, semi-solid mantle upon which the plates move
Water driven from plate catalyzes melting of mantle.
0
25
miles
50
75


location represented by figures 4.2 and 4.3, where the western edge of the Sierra Nevada Batholith intrudes the Jurassic terrane rocks
granite plutons solidifying to form the Sierra Nevada Batholith (future high Sierra)
EAST
Andean-type volcanoes (now eroded away)
accretionary wedge (future Coast Ranges)
Jurassic terrane rocks (future western Sierra foothills)
thrust faults and folded rocks (future western Nevada, now busted up by Basin and Range faulting)
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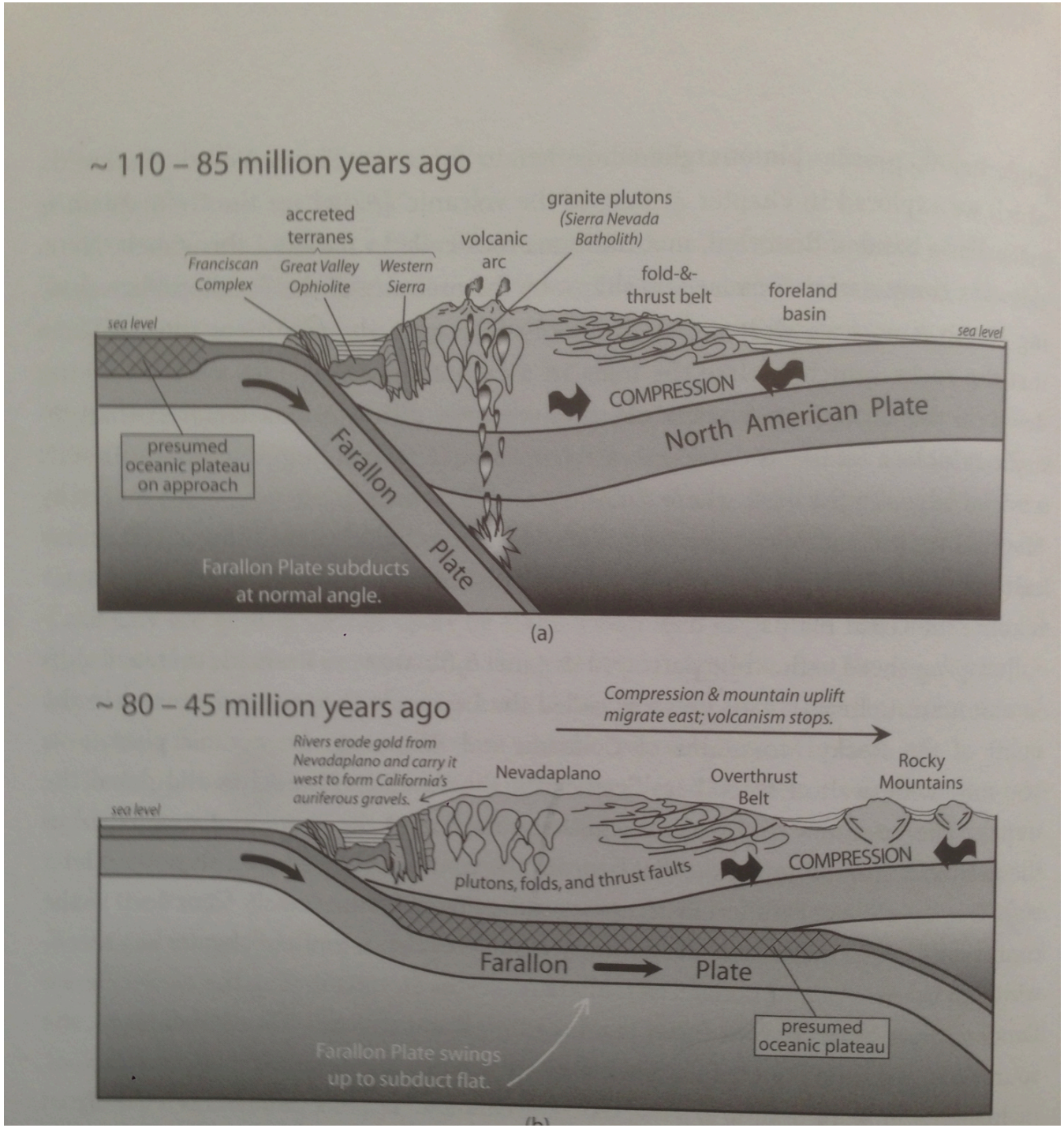
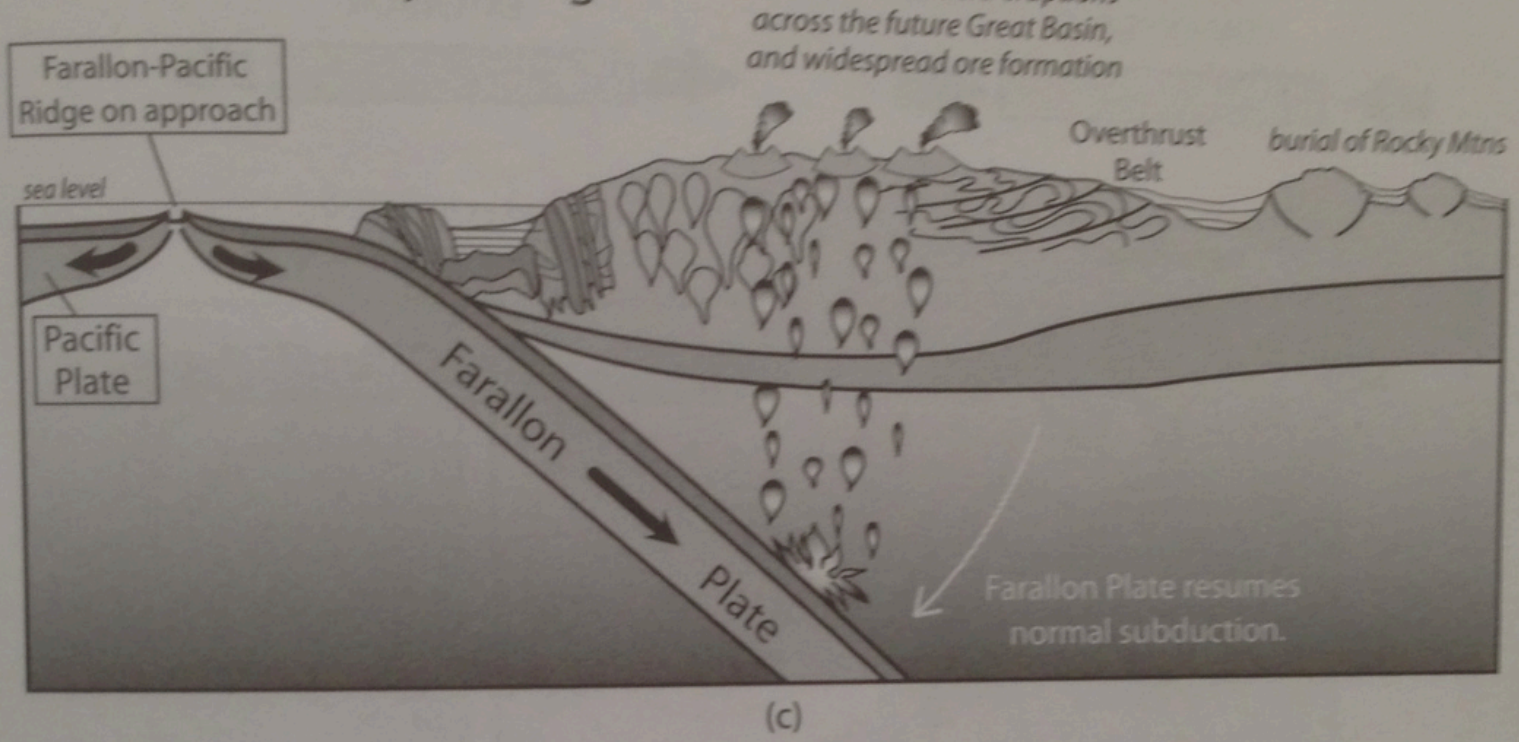
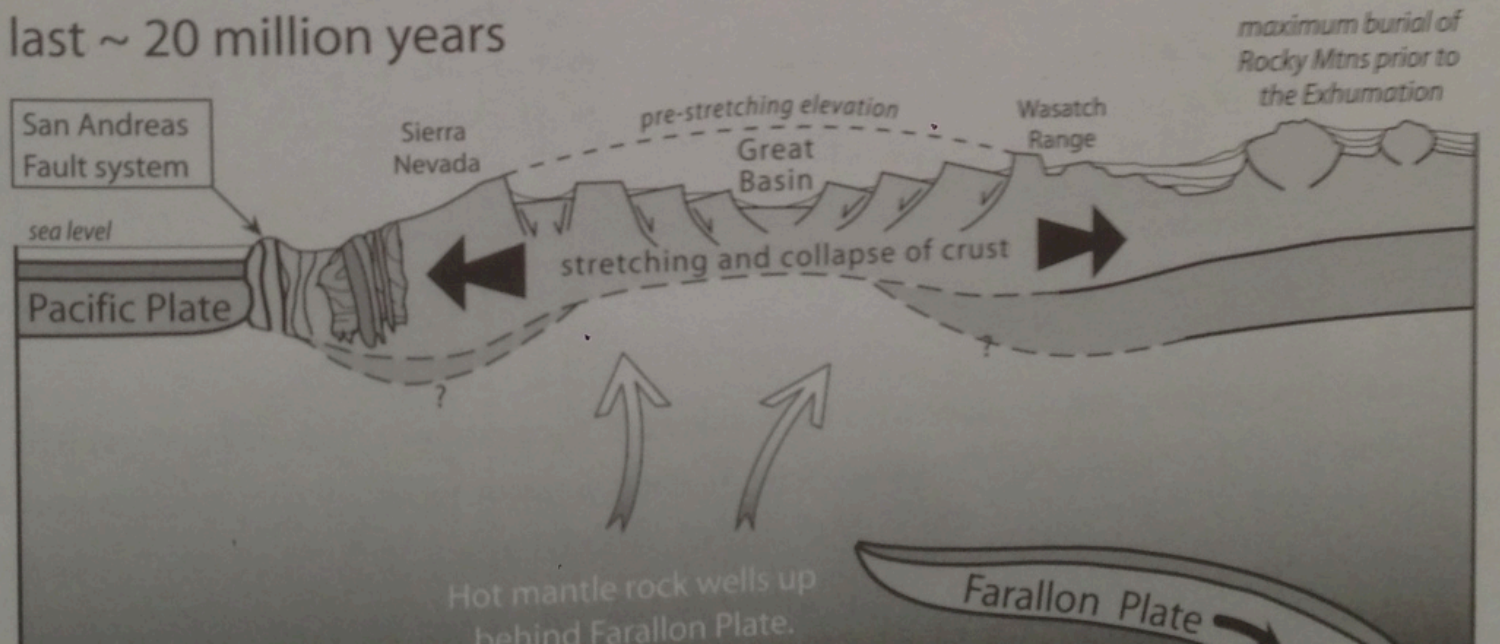

~ 110 – 85 million years ago
accreted terranes
Franciscan Complex
Great Valley Ophiolite
Western Sierra
volcanic arc
granite plutons (Sierra Nevada Batholith)
fold-&-thrust belt
foreland basin
sea level
sea level
COMPRESSION
North American Plate
presumed oceanic plateau on approach
Farallon Plate
Farallon Plate subducts at normal angle.
(a)
~ 80 – 45 million years ago
Compression & mountain uplift migrate east; volcanism stops.
Rivers erode gold from Nevadaplano and carry it west to form California's auriferous gravels.
Nevadaplano
Overthrust Belt
Rocky Mountains
sea level
plutons, folds, and thrust faults
COMPRESSION
Farallon
Plate
presumed oceanic plateau
Farallon Plate swings up to subduct flat.
(b)



(c)

last ~ 20 million years



Discussion

Thank you,

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Discussion

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